

THE MINERAL INDUSTRY OF NORWAY

By Harold Newman

Since the discovery of North Sea petroleum in the late 1960's, petroleum production became the most important mineral activity in Norway. It was, at 17%, the largest mineral contributor to the gross national product (GDP) in 1995 and represented about 45% of total exports. Readily available hydroelectric power and ice-free ports facilitated the growth of energy-intensive industries, namely production of aluminum, ferroalloys, magnesium, and silicon metal.

Based on the results of a country-wide referendum, the Government rejected membership in the European Union (EU). Despite this, the Government was reviewing its tax and mining laws with the intent of becoming more competitive and conforming to member countries' laws. The Government would refund up to 50% of the cost of exploration drilling, and additional grants would provide up to 35% of the capital cost of developing certain minerals and specific areas (mainly north of Trondheim). While liberalization of mining laws could attract new investors in exploration, stringent environmental laws might inhibit traditional extraction.

Laws for metallic ore mining were relatively simple. Mineral rights were obtained by filing claims and maintained by payment of small annual fees. In addition to a 28% corporate tax, there were also municipal and county taxes ranging from 7.5% to 13.5%. The Norwegian mining laws for industrial minerals were more complicated and often overlapping. While most of the minerals were regulated by special mining laws, aggregates and sand and gravel were subject to construction laws.

Production of metallic ores has fallen gradually for many years, as existing mines were being depleted and no major new mines were replacing those being exhausted. This decline of metallic mineral output has been partially offset by increased production of industrial minerals. (*See table 1.*)

The Norwegian economy remained dependent on foreign trade and more than one-half of the GNP was derived from it. About 75% of the minerals consumed were imported. Petroleum was the most significant mineral commodity export, followed by metals and industrial minerals, mainly dimension stone.

The Norwegian Government's involvement in the mineral industry remained substantial, especially in offshore hydrocarbon production. The Government, through state-owned Den norske stats oljeselskap A/S (Statoil), continued to control all hydrocarbon production and refining. The rest of the mineral industry was dominated by Elkem A/S and

Norsk Hydro A/S. (*See table 2.*)

The Government of Norway and Norsk Hydro signed a 50 year agreement that allows the company to make use of the water, considered to be property of the state, in four of its hydro-power plants, in return for about \$200 million. These four plants produce about 3 billion kilowatt hours of electricity a year. The agreement, if approved by the Norwegian Parliament, provides some predictability for long term power costs and facilitates Norsk Hydro's expansion plan that could increase the Årdal aluminum smelter's capacity by 50,000 t/yr to more than 240,000 t/yr.

The first phase of the expansion, expected to take a year with an estimated cost of \$42 million, would involve installing 26 new reduction cells, a new gas cleaning system, and raised rectifier capacity in the existing potroom. The second phase, expected to take 2 to 3 years with an estimated cost of \$146 million, would replace the older Søderberg technology with prebaked anode cell technology in a second potroom.

Elkem Aluminium ANS, a division of Elkem A/S, operated two primary aluminum smelters in Farsund and Mosjoen, with a combined capacity of about 250,000 t/yr. Elkem has reportedly initiated a major program to modernize its Farsund plant. The \$36 million investment aimed to reduce air and water pollution and was scheduled to be completed by 1998.

In 1995, two copper-containing sulfide mines were in operation with a combined production, at Royrvik and Gjersvik, estimated to be about 0.7 million metric tons (Mt). The largest producer of iron ore in Norway was Sydvaranger A/S. The mine, located in northern Norway near the Finnish border, produced about 1.7 Mt iron pellets, most of which were exported to Germany and the United Kingdom. Because reserves reportedly amounted to about only 10 Mt, the mine was expected to close in 1996.

Titania A/S was reportedly one of two hardrock ilmenite producers in the world. The mine in Tellnes reportedly averaged about 2.5 Mt of crude ore from which about 800,000 t of concentrate was produced with a 44.4% titanium oxide content and small amounts of magnetite and pyrite concentrate. About 20% of the concentrate was used as raw material for titanium dioxide pigment production by the sulfate process at Kronos Titan A/S in Fredrikstad.

BHP was reportedly planning to invest about \$30 million in the 350,000 t/yr capacity ilmenite smelter in Tyssedal,

owned by Tinfos Titan & Iron KS. Concentrate was to shipped from BHP's Beenup Mine in Western Australia. Tinfos was expected to start producing chlorinatable slag based on Australian ilmenite after 1997. The pigment industry was changing from the sulfate process to the chlorine process owing to environmental aspects. Because of a high magnesium and chromium content, Norwegian ilmenite can only be used in the sulfate process.

Norzik A/S, jointly owned by Boliden AB of Sweden and RTZ Corp. of the United Kingdom, announced its smelter would reach its peak capacity of 140,000 t/yr in 1996. Lower production in 1995 was the result of a ten week maintenance shutdown at one production unit.

Norway has a long coastline with excellent ports, favorable geology for a great variety of crystalline rock types, and situated relatively close to the European market. By value, about 70% of the industrial minerals produced and about 85% of the natural stone produced were exported.

The annual production value for industrial minerals was reported to be about \$305 million; for dimension stone and slate, it was about \$130 million. Opening of the mineral industry to foreign investors was insuring a steady growth, about 5% to 6% per year, of industrial mineral output.

Some of the world's largest resources of high quality olivine are on the southwestern coast of Norway in the Sunnmøre-Nordfjord area. A/S Olivin, with plants at Åheim and Stranda, was the world's leading producer of olivine products. The 2-Mt capacity open pit mine was 4 km from the plant and the port. The olivine ore was transported in a

tunnel by conveyor belt.

Production of dimension stone has been steadily increasing as the industry, composed of many small firms, has been expanding. The most sought after stone was larvikite, a syenite with a feldspar lamellar structure that gives it a special luster. Also, banded dolomite from the Fauske area was highly regarded.

Offshore hydrocarbon production will remain Norway's principal economic activity for the next several decades. It represented about 33% of the country's total export earnings and accounted for 13% of GNP in 1995. Norway produced an average of about 2.71 million barrels per day (Mbbbl/d) of crude oil in 1995 and was ranked number seven in world production.

Thirty-four exploration wells, including 21 wildcats and 13 appraisal wells, were completed or temporarily abandoned on the Norwegian continental shelf in 1995. Of these, 28 were in the North Sea and 6 in the Norwegian Sea.

In 1995, the Government approved the development of the Norne, Njord, Yme, Yme Beta East, Gullfaks, and Tordis East oil fields and the Loke Triassic, My, and Valhal (new wellhead platform) gas fields. The NorFra gas transport system to France was also approved.

To counter an anticipated decline in production over the next decade, the government has been encouraging the discovery of new resources. Exploration has been focused on finding resources near existing infrastructure. Greater emphasis will be placed in coming years on areas that are currently unexplored.

TABLE 1
NORWAY: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity	1991	1992	1993	1994	1995 e/
METALS					
Aluminum:					
Primary	832,558 r/	812,850	887,461 r/	858,190	846,735 2/
Secondary	63,066 r/	57,043 r/	51,987 r/	47,994	65,000
Cadmium, smelter	227	247	213 r/	288	250
Cobalt	1,983 r/	2,293 r/	2,414 r/	2,823	2,804
Copper:					
Mine output:					
Concentrate	84,592 r/	49,645 r/	36,002 r/	31,116	30,000
Cu content	17,393 r/	12,668 r/	8,696 r/	7,412	6,800
Metal, primary and secondary:					
Smelter	38,444 r/	39,259 r/	37,205 r/	39,516	36,000
Refined	38,400	39,300	37,200	39,400	34,000
Gold e/ kilograms	1,000	1,200	800	200	--
Iron and steel:					
Iron ore and concentrate:					
Gross weight thousand tons	2,209 r/	2,152 r/	2,162 r/	2,364	2,200
Fe content do.	1,593	1,527	1,532	1,650	1,600
Metal:					
Pig iron do.	61	70	73	70	70
Ferroalloys:					
Ferrochromium do.	83	102	80	120	100
Ferromanganese do.	173	203	226	249	250
Ferrosilicomanganese do.	227	213	219	197	200
Ferrosilicon (75% basis) do.	377	367	400	456	470
Silicon metal e/ do.	65	60	60	60	50
Other e/ do.	14	14	14	14	15
Total do.	939	959	999	1,096	1,085
Steel, crude do.	438	446	505 r/	454	470
Semimanufactures, rolled e/ do.	300	300	290	300	300
Lead, mine output:					
Concentrate	6,739 r/	7,083 r/	3,224 r/	5,953	3,000
Pb content	3,517 r/	3,767 r/	1,698 r/	3,096	1,000
Magnesium, primary	44,322 r/	30,404 r/	27,300	27,635	28,000
Nickel:					
Mine output:					
Concentrate	21,156 r/	31,306 r/	31,719 r/	26,470	26,000
Ni content	1,958	3,398 r/	3,462 r/	2,938	3,000
Metal, primary	58,730 r/	55,686 r/	56,817 r/	67,955	53,237
Platinum group metals e/ 3/ kilograms	1,500	1,500	1,500	1,500	1,500
Titanium:					
Ilmenite concentrate thousand tons	625	708	713	826	800
TiO2 content do.	277	318	315	320	325
Zinc:					
Mine output:					
Concentrate	37,690	41,055 r/	27,469 r/	30,117	30,000
Zn content	18,886 r/	21,658 r/	14,327	15,869	16,000
Metal, primary	124,916 r/	125,564 r/	129,192 r/	131,921	130,000
INDUSTRIAL MINERALS					
Cement, hydraulic thousand tons	1,147 r/	1,266	1,344 r/	1,444	1,450
Feldspar e/	90,000	100,000	75,000 r/	62,905 2/	60,000
Graphite e/	6,930	7,000	6,500	5,566 2/	5,000
Lime, hydrated, and quicklime e/ thousand tons	100	100	100	100	100
Mica, flake e/	3,000	3,000	3,000	3,000	3,000
Nepheline syenite e/ thousand tons	292	334	350	279 2/	300
Nitrogen, N content of ammonia do.	384	343	315	271	275
Olivine sand do.	2,505	2,789 r/	2,955 r/	3,109	3,000
Pyrite do.	306	247	92	1	--
Stone, crushed:					
Dolomite do.	600	650	650	743	750
Limestone do.	4,000	3,500	3,500	4,357	4,000
Quartz and quartzite do.	800	900	900	891	900

See footnotes at end of table.

TABLE 1--Continued
NORWAY: PRODUCTION OF MINERAL COMMODITIES 1/

(Metric tons unless otherwise specified)

Commodity	1991	1992	1993	1994	1995 e/	
INDUSTRIAL MINERALS--Continued						
Sulfur:						
Pyrite, S content e/	thousand tons	121	125	125	125	125
Byproduct of: e/						
Metallurgy	do.	75	75	75	75	75
Petroleum	do.	15	15	15	15	15
Total sulfur	do.	211	215	215	215	215
Talc, soapstone, steatite e/	do.	80	60	50	28	30
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades	thousand tons	389	449	309 r/	301	300
Gas, natural:						
Gross	million cubic meters	28,300	27,700	28,100 r/	30,833	47,000
Marketed 4/	do.	25,000 e/	27,700	28,500	26,800	28,000
Peat: e/						
For agricultural use	do.	30	30	30	30	30
For fuel use	do.	1	1	1	10	10
Petroleum:						
Crude 5/	thousand 42-gallon barrels	679,184 r/	793,553 r/	855,643 r/	913,632	980,000
Natural gas liquids	do.	17,204	17,200	25,342 r/	24,500	27,300
Refinery products:						
Naphtha e/	do.	4,200	4,200 2/	4,000	1,000	1,000
Gasoline	do.	23,228 r/	28,087	28,680 r/	27,149	28,000
Kerosene	do.	6,549 r/	8,134 r/	8,499 r/	9,068	10,000
Distillate fuel oil	do.	44,796 r/	47,274 r/	48,515 r/	55,000	55,000
Residual fuel oil	do.	9,960	11,200	10,700 r/	11,255	12,000
Other e/	do.	4,000	4,000	4,000	4,000	4,000
Refinery fuel and losses e/	do.	4,000	4,000	4,000	4,000	4,000
Total e/	do.	96,733 r/	106,895 r/	108,394 r/	111,472 r/	114,000

e/ Estimated. r/ Revised.

1/ Table includes data available through May 1996.

2/ Reported figure.

3/ Data represent exports.

4/ Reported as total methane sales.

5/ Excluding natural gas liquids.

TABLE 2
NORWAY: STRUCTURE OF THE MINERAL INDUSTRY FOR 1995

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Aluminum	Hydro Aluminium A/S (Norsk Hydro A/S 70%)	Smelters at Ardal, Hoyanger, Karmoy, and Sunndalsora	600
Do.	Elkem Aluminium (Elkem A/S 50% and Alcoa 50%)	Smelters at Farsund and Mosjoen	250
Do.	Sor-Norge Aluminium A/S (Alusuisse 50% and Hydro Aluminium 49%)	Smelter at Odda	50
Cadmium	Norzink AS (Boliden AB 50% and Rio Tinto Minerals Development Ltd.)	Smelter at Eittheimsneset	0.3
Cement	Norcem A/S	Plants at Brevik and Kjøpsvik	2,150
Coal	Store Norske Spitsbergen Kulkompani A/S	Mines at Longyearbyen and Svea	450
Cobalt	Nikkelverk A/S (Falconbridge Nickel Mines Ltd. 100%)	Smelter at Kristiansand	3
Copper:			
Ore, Cu content	Grong Guber A/S (Norsulfid A/S 100%)	Mines at Roysvik and Gjersvik	8
Do.	Nikkel og Olivin AS (Norsulfid A/S 100%)	Mine at Narvik	1
Metal	Nikkelverk A/S (Falconbridge Nickel Ltd 100%)	Smelter at Kristiansand	40
Dolomite	Franzefoss Bruk A/S	Mine at Ballagen	350
Do.	Norwegian Holding A/S	Mines at Hammerfall, Logavlen, and Kvitblikk	500
Feldspar	Franzefoss Bruk A/S	Mine at Lillesand	100

TABLE 2--Continued
NORWAY: STRUCTURE OF THE MINERAL INDUSTRY FOR 1995

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners	Location of main facilities	Annual capacity
Ferroalloys	Elkem Rana (Elkem A/S 100%)	Ferrochromium plant at Mo i Rana	140
Do.	Elkem Sauda (Elkem A/S 51% and BHP 49%)	Ferromanganese plant at Sauda	250
Do.	Elkem PEA (Elkem A/S 51% and BHP 49%)	Ferromanganese plant at Porsgrunn	200
Do.	Elkem Salten (Elkem A/S 100%)	Ferrosilicon plant at Straumen	85
Do.	Elkem Bjolvefossen (Elkem A/S 100%)	Ferrosilicon plant at Alvik	60
Do.	Elkem Thamshavn (Elkem A/S 100%)	Ferrosilicon plant at Orkanger	60
Do.	Finnfjord Smelterverk, Rana Metal (Fesil 100%)	Ferrosilicon plant at Mo i Rana	140
Do.	A/S Hafslung Metal (Fesil 100%)	Ferrosilicon plant at Sarpsborg	75
Do.	Ila og Lilleby Smelterverk (Fesil 100%)	Ferrosilicon plant at Finnsnes	60
Do.	Oye Smelterverk (Tinfos Jernverk A/S 100%)	Silicomanganese plant at Kvinesdal	235
Iron, metal	Ulstein Jernstoperi A/S	Hordvikneset	10
Iron ore	Rana Gruber A/S (Norsk Jernverk Holding A/S 100%)	Mine at Mo i Rana	2,000
Do.	A/S Sydvaranger (Government 87.45%)	Bjornevatn Mine at Kirkenes	1,500
Lead ore, Pb content	A/S Bleikvassli Gruber (A/S Sydvaranger 100%)	Mine at Bleikvassli	2
Lime	Hylla Kalkverk (Nikolai Bruch A/S 100%)	Verdal/Trondheim Mine and plant	80
Do.	A/S Norsk Jernverk	Plant at Mo i Rana	48
Do.	Ardal og Sunndal Verk A/S	More og Romsdal Mine at Surnadal	20
Do.	Breivik Kalkverk A/S	Alesund Mine at Larsnes	20
Do.	Mjoendalen Kalkfabrik	Plant at Asen/Drammen	7
Limestone	Norcem A/S	Dalen, Bjortvedt, and Kjopsvik Mines	1,600
Do.	Vardelskalk A/S (Franzefoss Burk A/S 100%)	Sandvika Mine	800
Do.	Breivik Klakverk A/S	Visnes and Glaerum Mines	500
Magnesium	Norsk Hydro A/S (Government 51%)	Plant at Porsgrunn	35
Natural gas			
million cubic meters	Den Norske Stats Oljeselskap A/S	Gama, Gullfaks, Sleipner Ost, and Statfjord Fields	12,270
Do.	Phillips Petroleum Company Norway	Ekofisk Field	9,900
Do.	Elf Petroleum Norge A/S	Frigg, Heimdal, and Ost-Frigg Fields	5,750
Do.	Norsk Hydro Produksjon A/S	Troll-Oseberg Field	2,600
Do.	BP Petroleum Development of Norway	Gyda and Ula Fields	1,040
Do.	Esso Norge as	Odin Field	1,000
Do.	Amoco Norway A/S	Hod and Valhall Fields	910
Nepheline syenite	North Cape Mineral A/S (Unimin Corp. 84%)	Mine at Stjerneoy	350
Nickel:			
Ore, Ni content	Nikkel og Olivin A/S (Norsulfid A/S 100%)	Mine at Narvik	3
Do.	Titania A/S (Kronos Norge A/S 100%)	Mine at Tellnes	0.5
Metal	Nikkelverk A/S (Falconbridge Nickel Mines Ltd. 100%)	Smelter at Kristiansand	60
Olivine	A/S Olivin	Aheim Mine at Sunnmøre	2,500
Do.	Franzefoss Bruk A/S	Lefdal Mine at Bryggja	500
Do.	Industrimineraler A/S	Stranda Mine at Nordfjord	300
Petroleum barrels per day	Den Norske Stats Oljeselskap A/S	Gullfaks, Statfjord, Tommeliten, and Veslefrikk Fields	1,069,300
Do.	Norsk Hydro Produksjon A/S	Brage, Mime, and Oseberg Fields	566,200
Do.	Phillips Petroleum Company Norway	Ekofisk Field	237,500
Do.	Saga Petroleum A/S	Snorre Field	170,000
Do.	BP Petroleum Development of Norway	Gyda and Ula Fields	155,000
Do.	A/S Norske Shell	Draugen Field	90,000
Pyrite	Folldal Verk A/S (Norsulfid A/S 100%)	Mine at Hjerkin	10
Quartzite	Elkem Tana (Elkem A/S 100%)	Mine at Tana	540
Do.	Elkem Marnes (Elkem A/S 100%)	Mine at Sandhornoy	200
Do.	Vatnet Kvarts A/S	Mine at Nordland	150
Do.	Snekkevik Kvartsbrudd	Mine at Kragero	110
Steel	Fundia AB (Norsk Jernverk 50% and Rataruukki 50%)	Plants at Christiania, Spigerverk, Mandal Stal, and Moi Rana	600
Talc	A/S Norwegian Talc (Pluuss-Staufer AG 51%)	Mine/plant at Altermark/Knarrevik and Framfjord	90
Do.	Kvam Minerals A/S	Mine/plant at Kvam	6
Titanium, concentrate	Titania A/S (Kronos Norge A/S 100%)	Mine at Tellnes	800
Zinc:			
Ore, Zn content	Grong Guber A/S (Norsulfid A/S 100%)	Mines at Royrvik and Gjersvik	10
Do.	A/S Bleikvassli Gruber (A/S Sydvaranger 100%)	Mine at Bleikvassli	10
Metal	Norzik A/S (Boliden Mineral AB 50%)	Smelter at Eittheimsneset	137